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COMBAT CASUALTIES IN A CONVENTIONAL AND CHEMICAL WARFARE ENVIRONMENT

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Summary

Problem

Soldiers are faced with the possibility of fighting in an environment where chemical and conventional weapons are used at the same time. Conventional weapons could cause wounds that would render the use of the protective mask ineffective and thus subject the soldier to the deleterious effects of the chemical agent. The extent of deaths due to protective mask failure under these circumstances is unknown.

Methods

A surgical data base describing the wounds of 2,021 battlefield casualties, constructed between January and June 1968 at the Naval Support Activity Hospital, Danang, South Vietnam, was used in this analysis. Wound descriptions that would be expected to cause ventilatory interference or failure of the mask to seal against the face were identified. Soldiers having any one of these wounds were included in the protective mask failure group. The two other groups were those that were released alive and those that actually died in Vietnam due to conventional wounds.

Results

Using the criteria outlined above, it was predicted that 34.0% of the casualties requiring hospitalization would not be able to use the protective mask effectively due to wounds from conventional weapons, and that this could result in additional death, incapacitation, or complications in treatment, depending on the effect of the chemical agent.

Conclusions

The combined use of conventional and chemical weapons will present field hospitals with an additional challenge in the triage process and medical management. Strategies should be developed to deal with anticipated problems.



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Introduction

Statistical summaries (1,2) of the numbers and rates of soldiers who were wounded, killed in action, died of wounds, admitted to military treatment facilities, etc. for WWII, the Korean, and Vietnam Wars provide important information for today's military medical planners. One of the valuable aspects of these summaries is that they documented what actually took place. To the extent that these data can be used to make predictions and improve readiness, they are quite valuable. However, a limitation of using these statistics for present planning is that they do not include all situations with which combatant forces might have to deal. For example, the last time chemical warfare agents involving United States combatants were used was during World War I (3), and thus information about chemical warfare deaths and injuries is not available in the statistical summaries of more recent wars. But military medical planners are nonetheless faced with many questions that pertain to chemical warfare and will have to use available information, even if it is less than ideal. The purpose of this paper was to estimate one aspect of the effects of chemical warfare on combat casualties: how many soldiers injured by conventional weapons and requiring inpatient treatment would be unable to use a protective mask because of their wounds? The situations included are casualties who have conventional injuries, are unmasked and receive chemical exposure, and masked personnel who incur conventional injuries and subsequently or concomitantly are exposed to chemical agents.

Methods

The types of battlefield wounds that would prevent the soldier from being able to effectively use a protective mask were identified. Next, a computerized data base was searched to identify and then count the number of soldiers having any of these wounds. The rest of the methods section describes the Vietnam data base used in this analysis, defines the outcome groups, and elaborates on the rationale for choosing each one of the conventional wounds that would prohibit effective use of a protective mask.

Vietnam Data Base Description

A surgical data base (SDB) describing the wounds of 2,021 allied soldiers (of which 1,182 were U.S. Marines) injured in combat in Vietnam and admitted to the Naval Support Activity Hospital (NSAH), Danang surgical service between January and June, 1968 was used in this study. These data were collected by Drs. J. Garrick and L.G. Carey and other Surgical Research Unit staff at NSAH and are described in another paper (4). The SDB also identified all of the soldiers that actually died while hospitalized at NSAH.

Outcome Groups

The three outcome groups were: combat casualty deaths that occurred in Vietnam due to conventional weapons, deaths due to protective mask failure, and survivors. Combatant deaths included all soldiers that actually died at NSAH during the study period. Since these were actual deaths caused solely by conventional weapons, their outcome would not be changed by the use of chemical weapons. Thus, their wounds were not evaluated to see if they met the inclusion criteria for the protective mask failure group. Protective mask failure included the group of soldiers with the conventional weapon wounds that would prohibit effective protective mask use. For the purpose of this study, protective mask failure would occur if chemical warfare agents were used in

conjunction with, or subsequent to, injury by conventional weapons. Thus, protective mask failure included any inability to seal due to the nature of the injury and/or the likelihood of mask damage, or the exacerbating effect of the mask to breathing resistance. Protective mask failure did not include the inability of the equipment to perform. The survivor group included those casualties not meeting the criteria for the combatant death or protective mask failure groups, and thus would survive if given adequate medical treatment.

Conventional Weapon Wounds Prohibiting Effective Protective Mask Use

Wounds caused by conventional weapons that would be expected to prohibit effective protective mask use were identified and categorized as ventilatory interference or failure of protective mask to seal against the face. Ventilatory interference included wounds to the trachea, oral cavity, and penetrating wounds to the thorax. Tracheal wounds were included because they would significantly block airflow or in some cases result in the trachea being patent to the environment, thus bypassing the protective mask. Oral cavity wounds would be expected to cause an accumulation of saliva, blood, and serum which would have to be cleared to maintain adequate ventilation. This would not be possible if the mask had to be worn continuously. Penetrating wounds to the thorax would cause a pneumothorax, which combined with the additional resistance from the mask, would be expected to cause suffocation.

The wound descriptions included in the failure to achieve a protective mask seal category were facial and head penetrating wounds. Facial wounds would distort the natural contour of the face and thus not allow the mask to seal properly, which in turn would cause the soldier to breathe the chemical agent. Head penetrating wounds were included in this group because the resulting skull fractures would make it impossible to tighten the protective mask straps sufficiently to achieve an effective seal.

Results

Based on the frequencies of the wound descriptions for the 2,021 NSAH admissions it is predicted that 34% of these admissions would have had wounds that would cause protective mask failure. Most (63.1%) would survive. Another 2.9% actually did die due solely to conventional wounds. Therefore, it is estimated that all deaths would amount to 36.9% of the total number of casualties in a chemical and conventional warfare environment.

Discussion

The results showed that 34.0% of the battlefield casualty sample admitted to a military treatment facility in Vietnam had wounds that would prevent the effective use of the protective mask. In the most extreme circumstance, exposure to any chemical agent at a very high concentration, whether it be a nerve, blister, blood, or lung-damaging agent could be fatal to these casualties. The severity of the condition resulting from chemical exposure would depend on a number of factors including the type of agent, weather, and terrain. This study does not take into account injuries which could interfere with the use of protective clothing which, in addition to a mask, is essential in a chemical warfare environment. Thus, 34% may be a conservative estimate of the number of combat casualties who would be vulnerable to the effects of chemical agents.

Exposure of conventional warfare casualties to incapacitating doses of chemical warfare agents would greatly complicate the management and treatment of their condition. The hospital staff would have to decide whether or not the casualties' surgical or medical condition would take priority over decontamination (3).

Several aspects about the methods used in this analysis, of which a change in any one could alter the outcome, need to be examined. First, the SEB was constructed during Vietnam, and it is likely that many of the elements that determined the medical outcomes at that time have changed or will change. These elements include the types of weapons used, the ease of access to medical treatment via the medical evacuation system, the number and mix of medical specialty staff available to treat the wounded, and the state of the art of medical science. Another aspect of this study is that the data base included only those soldiers that required hospitalization or were transported to a medical facility. Thus, soldiers that were treated outside of the hospital setting were not considered in these calculations. Yet another consideration is that the wounds chosen in this analysis may not include all reasonable possibilities. For example, abdominal pain due to an abdominal penetrating wound could significantly impair respiratory effort. Another possibility is that soldiers with upper extremity wounds and needing to don a protective mask would be unable to do so because of these wounds.

The effect of psychological reactions of wounded soldiers who have to wear the confining chemical defense ensemble was not possible to evaluate in this study, but based on a study by Brooks, et al. (5) of soldiers' reactions during training this could be an important factor. Here, panic would be the most important consideration. The effect of heat intolerance caused by wearing the protective clothing and the use of antidotes are other factors to be considered.

Conclusions

The possible outcomes for soldiers wounded by conventional weapons in a chemical warfare environment have been explored. Many additional deaths would be expected to occur, perhaps as many as one-third of the battle-injured, but the exact outcome is difficult to predict. Further computer modeling would provide medical planners with useful information to develop strategies for dealing with anticipated problems.

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